

CLAIMS

1. An ultrasonic motor comprising:

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being fixedly mounted through the arm portion so that the contact portion abuts on a driven element;

wherein the vibrating element has a body portion and a length of the body portion in a direction in which the vibrating element extends and contracts by application of the AC voltage is 1 to 20mm.

2. The ultrasonic motor as claimed in claim 1, wherein the length of the body portion in the extension-and-contraction direction is less than 18mm.

3. The ultrasonic motor as claimed in claim 1, wherein the arm portion is arranged at a substantially central portion of the body portion in the extension-and-contraction direction.

4. The ultrasonic motor as claimed in claim 1, wherein the body portion has a short side substantially perpendicular to the extension-and-contraction direction of the body portion, and the contact portion is arranged at a substantially central portion of the short side.

5. The ultrasonic motor as claimed in claim 1, wherein the body portion has a short side substantially perpendicular to the extension-and-contraction direction of the body portion, and the contact portion is arranged at a portion of the short

side other than a substantially central portion thereof.

6. The ultrasonic motor as claimed in claim 1, wherein the body portion has a centerline in a direction parallel to the extension-and-contraction direction, and the contact portion is arranged at a portion other than the centerline.

7. The ultrasonic motor as claimed in claim 1, wherein the contact portion is arranged so as to protrude in the extension-and-contraction direction partly.

8. The ultrasonic motor as claimed in claim 1, wherein the vibrating element has a vibrational node, and the arm portion supports the vibrating element at the vibrational node.

9. The ultrasonic motor as claimed in claim 1, wherein the length of body portion of the vibrating element in the extension-and-contraction direction is longer than that in a direction perpendicular to the extension-and-contraction direction.

10. The ultrasonic motor as claimed in claim 1, wherein the vibrating element undergoes a complex vibration of combination of longitudinal vibration and bending vibration, and a resonant frequency of the longitudinal vibration is different from but close to that of the bending vibration.

11. An operating apparatus comprising:
a driven element; and
an ultrasonic motor comprising:

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an

AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being supported through the arm portion so that the contact portion abuts on the driven element;

wherein the vibrating element has a body portion and a length of the body portion in a direction in which the vibrating element extends and contracts by the application of the AC voltage is 1 to 20mm;

wherein driving force is generated by the vibration of the vibrating element, and the driven element is driven by means of the driving force from the ultrasonic motor.

12. The operating apparatus as claimed in claim 11, wherein the driven element has a rotor and the rotor is rotatively driven by means of the driving force from the ultrasonic motor.

13. The operating apparatus as claimed in claim 11, wherein the driven element has a circumferential surface, and the contact portion of the ultrasonic motor abuts on the circumferential surface of the driven element so that the driven element is driven by means of the driving force from the ultrasonic motor.

14. An optical apparatus comprising:

an optical system;

a driven element;

an ultrasonic motor comprising:

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element

being laminated in this order, and the vibrating element being supported through the arm portion so that the contact portion abuts on the driven element;

wherein the vibrating element has a body portion and a length of the body portion in a direction in which the vibrating element extends and contracts by the application of the AC voltage is 1 to 20mm; and

a switching mechanism for the optical system, the switching mechanism being operated in association with the driven element;

wherein driving force is generated by the vibration of the vibrating element, and the driven element is driven by means of the driving force from the ultrasonic motor.

15. The optical apparatus as claimed in claim 14, wherein the switching mechanism has at least one of a diaphragm portion, a filter portion, and a mechanical shutter.

16. An electric instrument comprising:

a driven element; and

an ultrasonic motor comprising:

a vibrating element which includes a first piezoelectric element that undergoes extension and contraction by application of an AC voltage, a reinforcing plate having a contact portion and an arm portion, and a second piezoelectric element that undergoes extension and contraction by application of an AC voltage, the first piezoelectric element, the reinforcing plate and the second piezoelectric element being laminated in this order, and the vibrating element being supported through the arm portion so that the contact portion abuts on the driven element;

wherein the vibrating element has a body portion and a length of the body portion in a direction in which the vibrating element extends and contracts by the application of the AC voltage is 1 to 20mm;

wherein driving force is generated by the vibration of the vibrating element, and the driven element is driven by means of the driving force from the ultrasonic motor.